



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.



EDWARD EMERSON BARNARD

PUBLICATIONS
OF THE
Astronomical Society of the Pacific.

Vol. XXIX.

San Francisco, California, April, 1917

No. 168

ADDRESS OF THE RETIRING PRESIDENT OF THE
SOCIETY IN AWARDING THE BRUCE GOLD
MEDAL TO MR. EDWARD EMERSON BARNARD.

BY SIDNEY D. TOWNLEY.

In the year 1897, Catherine Wolf Bruce of New York gave the sum of \$2500 to the Astronomical Society of the Pacific for the endowment of a medal fund. The conditions of the gift are that the interest of this fund is to be used for the purchase of a gold medal to be awarded not oftener than once a year, for "distinguished services to astronomy." The statutes for the award of the medal are unique on account of the fact that the directors of the Society are aided in the selection of the medalist by the directors of six of the leading observatories of the world. When a medalist is to be selected, the Secretary of the Society sends letters to the directors of the Berlin, Paris, Greenwich, Harvard, Yerkes and Lick observatories, asking each of them to nominate three astronomers whom they consider worthy of the receipt of the medal. The directors of the Society must then choose the medalist from the persons so nominated. It is thus made certain that the medal will always be awarded to one of the leading astronomers of the world.

The first award, in 1898, was made to the late Simon Newcomb, the most distinguished astronomer that America has yet produced. Succeeding awards were made to Arthur Auwers, a German astronomer, noted in what is known as the "old line astronomy"; to Sir David Gill, an Englishman, for many years director of the Observatory of the Cape of Good Hope, and prominent in many lines of research; to Giovanni Schiaparelli, an Italian, famous as the discoverer of the so-called canals of *Mars*; to Sir William Huggins, an

Englishman, an amateur astronomer in the best sense of the word, a pioneer in the application of the spectroscope to the study of the stars; to Hermann Carl Vogel, a German, for many years director of the Astrophysical Observatory at Potsdam, and noted in many lines of research; to Edward Charles Pickering, an American, for forty years director of the Harvard College Observatory, noted organizer, executive and research worker; to George William Hill, the most brilliant mathematical astronomer America has produced; to Jules-Henri Poincare, the most famous French mathematical astronomer of the latter half of the last century; to Jacobus Cornelius Kapteyn, Dutch astronomer, noted for researches on stellar parallax; to Johann Oskar Backlund, late director of the Royal Observatory at Pulkowa, Russia, and prominent in several lines of research; to William Wallace Campbell, director of the Lick Observatory since 1900, noted executive and famous for his researches on the motion of stars in the line of sight; to George Ellery Hale, noted organizer, executive and the world's foremost student of the Sun.

It is now my privilege and pleasant duty to formally announce the fourteenth award of the Bruce gold medal to Edward Emerson Barnard, another noted American astronomer, and a man personally known to many of us assembled here this evening, and those of us who know him esteem it an honor to be reckoned among his friends. I first met Dr. Barnard at the Lick Observatory in 1891. On several occasions, I have enjoyed the hospitality of his home, and I esteem it a great privilege to be in a position this evening to make the address in presenting the Bruce medal to him. Our medalist's career has been a remarkable one, remarkable not only on account of his achievements in astronomy, but on account of the tremendous difficulties overcome during boyhood and early manhood.

At this point I think I cannot do better than to quote several paragraphs from an article on our medalist written by his colleague, Astronomer S. W. Burnham, the noted double star observer:

"Edward Emerson Barnard was born in Nashville, Tennessee, December 16, 1857. His early education was limited to two months' attendance at a common school, and such instruction as his excellent

mother could give him at home; and all of his acquirements in literature, the sciences, and languages in late years are the result of his own earnest efforts. Fatherless and destitute at the close of the war, he began at the age of eight or nine to work in a large photographic studio in Nashville, and continued to follow the occupation of photographer until 1883. During this time he had mastered every department of the photographic art, and had become invaluable to his employers as a faithful and accomplished assistant."

"From an early age he had been interested in optical matters, and this interest was increased by the use of the various lenses employed in the gallery. In 1876 a friend happened to leave in the young photographer's possession for a few days an old book, which he was delighted to find was a copy of Dr. Thomas Dick's *Practical Astronomer*. This book was studied with great avidity, and it awakened a thirst for astronomical knowledge which has never since ceased to be controlling. From the maps of the constellations and other engravings he speedily learned to identify the objects in the sky about which he had been reading, and the descriptions of celestial wonders had now a new interest. Then came the desire to possess some kind of telescope; and finally he obtained the object lens of a common spy-glass, and mounted it in a paper tube made by himself. This lens was about one inch in diameter, and, of course, was never intended for looking at celestial objects. Still it revealed the heavens as they can never be seen by the unaided eye, and showed the beautiful crescent form of Venus, and the disks of Jupiter and other planets."

"About this time a traveling show-man with a small glass for street exhibition turned up in Nashville, and young Barnard was a steady patron whenever nickels were sufficiently plentiful to warrant such a dissipation. This was not much of a telescope, but it was superior to the home-made affair he had constructed for himself. He resolved to have a better instrument of his own, and after practising the most rigid economy, he was enabled in 1877 to purchase a telescope of five inches aperture with a proper mounting, and a suitable equipment of eye-pieces and other accessories. In August of that year he met in Nashville Professor Simon Newcomb, the distinguished Washington astronomer, and received advice and kindly suggestions in regard to the future."

"His first systematic work of any importance with this telescope was a careful study of the planet *Jupiter*, and the popular scientific periodicals of the time contain many of his contributions on this subject. This planet, the largest of the solar system, seems to have had a special charm for the young astronomer at the very beginning of his use of the telescope; and, to repeat his own modest statement of the time, he 'began regular observations of *Jupiter*, and contributed his mite in drawings and observations of that changing old planet.' In late years this work was continued with instruments of much greater power, and finally culminated in the discovery of a new member of the magnificent Jovian system."

We thus see the heavy handicap under which our medalist worked during the early years of his life. Obligated to spend his days at work, he nevertheless studied alone at night, and thus obtained, not only a knowledge of astronomy, but also knowledge of various other branches that most of us obtain in the schools. In 1883, he was offered a scholarship in astronomy at Vanderbilt University, in Nashville. He was

soon placed in charge of the 6-inch telescope of the University, and not only continued his astronomical work, but took up regular work in the University, studying mathematics, physics, languages, etc., and graduated from the University in 1887.

In the following year, our medalist accepted a position on the staff of the Lick Observatory, which commenced its scientific work in that year. Since 1895, Dr. Barnard has held the position of professor of practical astronomy at the University of Chicago, his work being carried on, however, at the Yerkes Observatory, which is a department of that University.

We have seen from the above quotation that our medalist's astronomical work was begun with very meager equipment. He first became known to the astronomical world thru the discovery of comets. His first comet was discovered at Nashville with the little 5-inch telescope which he had purchased. This discovery was made in 1881 and the comet is known as Comet VI 1881; this was followed by Comet III 1882, and then by Comet II 1884, a short period comet of 5.4 years. Before leaving Nashville, he discovered nine comets and since that time has added seven more, making a total of sixteen comets to his credit.

Our medalist not only discovered comets, but made long series of observations of them, observations both of position and detail of structure. While at the Lick Observatory he took up the subject of photography of comets, and owing to his technical knowledge of and skill in this art, he was able to obtain some exquisite photographs of these interesting objects.

The first photograph of a comet was made, I believe, by Sir David Gill, assisted by some local photographers, at the Cape of Good Hope in 1882,—pictures of the great comet which appeared in that year. The next photographs of comets were made by our medalist at the Lick Observatory in 1892. In that year, he obtained a fine series of pictures of Swift's comet, discovered in March, 1892. This was pioneer work in the application of photography to the study of phenomena of the heavens. Since that time, our medalist has

probably photographed every bright comet that has appeared, so that a long series of photographs of these interesting objects stands to his credit. These photographs are not only interesting and beautiful, but very valuable because they constitute a permanent record of the changes in form and dimensions of the comets.

On the night of October 12, 1892, Mr. Barnard took a photograph of a portion of the Milky Way, in the constellation of *Aquila*. Upon developing the plate, to which an exposure of $4\frac{1}{2}$ hours had been given, a faint trail or streak was found, and this turned out to be the impression left by a comet,—the first comet discovered by photography.

Our medalist has made a special study of the planets and their satellites. One of the first pieces of astronomical work taken up by him with the little telescope at Nashville, was to study the planet *Jupiter* and make drawings of his surface markings. He made a special study of the great red spot which was visible for a number of years during the last quarter of the nineteenth century. These studies of *Jupiter* were later carried on with the great refractor of the Lick Observatory.

Venus, *Mars* and *Saturn* also received much attention from our medalist. He made a special study of the markings of *Mars* with the 36-inch telescope of the Lick Observatory, at the favorable oppositions of 1892 and 1894. The south polar cap of *Mars* received special attention during these two years and he not only made careful drawings of the cap, but also made micrometric measurements of its diameter. These measurements showed a remarkable agreement between the rates of decrease of the diameter of the cap, for these two years, with the progress of the Martian summer in the southern hemisphere of the planet. It is worthy of note that Dr. Barnard's drawings of *Mars*, altho our medalist possesses remarkably keen eyesight, do not show as much detail as the drawings of many others. He was never able to see the doubling of canals, and his drawings do not show any such wonderful system of canals as others have drawn. The same may be said of his drawings of the planet *Venus*, made with the large Lick refractor and the still larger refractor of the

Yerkes Observatory. He was able to see some indefinite shadings on the surface of this planet, but was never able to see the rather definite, radial lines which appeared on the drawings published by other observers. If these markings are real, then it would seem that all experienced observers should be able to see them. If our medalist is unable to see them, it would seem that his eyesight must be defective in some way, altho I can personally testify that his eyesight is remarkably keen in the perception of faint stars, satellites, asteroids and comets, and many series of difficult and accurate micrometric measurements give further evidence that our medalist possesses a remarkably keen and steady eye.

The most noteworthy result of Dr. Barnard's study of the planets was the discovery of the fifth satellite of *Jupiter* on September 9, 1892. I was holding a fellowship at the Lick Observatory at that time, and on the night of the discovery was working with the 12-inch telescope, observing variable stars. In an interim between observations, I went over to the 36-inch dome to see what Mr. Barnard was doing. I noticed that he seemed rather excited but he did not tell me of the discovery, wishing to observe the object on another night in order to make sure that it was really a satellite, and not a faint star nearly in line with *Jupiter*. Observations on the following night confirmed the discovery, and I had the privilege, on September 11th, of being the fourth person to see the satellite, the second being Mrs. Barnard, and the third Dr. Holden, director of the Observatory. This discovery was certainly one of the most remarkable ever made. Even with the large refractor, and *Jupiter* covered up by means of an opaque screen in the field of view of the telescope, the satellite showed only as a tiny speck of light. Dr. Holden, whose eyesight was perhaps somewhat subnormal, saw the satellite only with the greatest difficulty, and to my young eyes, it was no easy object, altho I had been observing faint variable stars for several years. Mr. Barnard, however, not only saw the satellite easily, but made a set of micrometric measurements of its distance from the limb of *Jupiter*.

Under date of September 11, 1892, an entry was made in my diary, and I venture to quote it here, in spite of the rather personal nature of the remarks:

"Professor Barnard made a great discovery Friday night (Sept. 9th) with the great telescope, it being a fifth satellite of the planet Jupiter. It is very faint and closer to *Jupiter* than any of the other four satellites. He observed it again last night, but did not tell anyone of his discovery until this morning. He told it to the Director first, and I have the honor of being the fourth person in the world to know that *Jupiter* has a fifth satellite. It is a great discovery, and I am highly pleased that Professor Barnard was the one to make the discovery for there is no man in the world that I would rather have seen make it. He is one of the most whole-souled men that ever lived, and has a wife just as whole-souled as he. I have taken a great liking to them both, and they seem to have taken something of a fancy to me."

I well remember also another evening on which I had occasion to note the remarkable keenness of Dr. Barnard's vision. On this occasion, he was observing a very faint asteroid with the 12-inch refractor. I happened to come in (I was very fond of Mr. Barnard, and he did not seem to mind having me come in at any time for a few minutes' chat, no matter how busy he might be), and he asked me if I wanted to see a very faint object. Of course I did, but as a matter of fact, I could get only the merest glimpse of the asteroid. He not only could see it, but made a set of measurements of its position by means of a bright micrometer wire!

Still another evidence of the keenness of his vision was the independent discovery of the *Gegenschein*, that faint patch of light sometimes visible in the midnight sky in the anti-solar point. The only time I ever saw the *Gegenschein* was one night at the Lick Observatory when it was pointed out to me by our medalist.

Mr. Barnard has not only remarkably keen vision, but also what might be called a "seeing eye" or a "seeing mind",—that is, the power to note and describe accurately that which is seen, and to place the correct interpretation upon the phenomena observed. For over thirty years he has been the most indefatigable watcher of the skies,—but he has been more than a watcher, more than an observer, he has been an interpreter as well, and to it all has added more than a

touch of scientific imagination which gives a certain freshness and charm to all his work.

Mr. Barnard's interest in and knowledge of photography have been mentioned, but his most noteworthy achievement in this line remains to be considered. I refer to his photographic studies of the Milky Way and of faint nebulosities. Dr. Barnard was a pioneer in this work, which was begun at the Lick Observatory in the early nineties, and the long series of photographs of the Milky Way taken at that time have never been surpassed. These beautiful photographs were made with a comparatively insignificant telescope,—a 6-inch portrait lens purchased in a secondhand shop in San Francisco. In the days of the slow, wet-plate photography, large lenses of short focus were necessary for successful portrait work. It was Mr. Barnard's intimate knowledge of the art of photography which enabled him to see that such a lens as this was just the thing for photographing the Milky Way. The uses and advantages of such a telescope have been set forth by Mr. Barnard in the following quotation¹:

"The main advantage of the portrait lens lies in its grasp of wide areas of the sky and its rapidity of action—this last result being due to its relatively short focus. The wide field makes it specially suitable for the delineation of the large structural details of the Milky Way; for the discovery and study of the great nebulous regions of the sky; for the investigation of meteors and the determination of their distances; and especially for the faithful portrayal of the rapid changes that take place in the forms and structures of comets' tails. There is other and important work where this instrument has shown its special adaptability; viz., in the discovery of asteroids and comets and variable stars; and when it becomes possible greatly to extend its field of view without lessening its rapidity, it will be of the greatest value in the study of the zodiacal light and the Gegenschein—two mysteries that perhaps for their explanation are only awaiting such a photographic investigation."

After many years of delay, due to various causes, the exquisite photographs of the Milky Way, taken at the Lick Observatory from 1892-1895, together with a large number of photographs of comets taken during the same period, were published a few years ago as volume XI, *Publications* of the Lick Observatory. Great difficulty was experienced in obtaining satisfactory reproductions of the delicate details

¹ *Astrophysical Journal*, 21, 35.

of these photographs, and it was only after years of experimenting with various processes that the volume was finally issued. The process used is an old, but little known one, called the collotype process. Mr. Barnard has given, in the preface to the volume just mentioned, an interesting account of this process, together with an historical account of the lens used and some valuable notes on celestial photography.

After leaving the Lick Observatory, Mr. Barnard's work in celestial photography was continued at the Yerkes Observatory with the Bruce photographic telescope, an instrument of Mr. Barnard's own design, having two photographic lenses, one of 10 inches aperture and 50 inches focus, and the other of $6\frac{1}{4}$ inches aperture and 31 inches focus. These two lenses, together with a guiding telescope, are firmly mounted together on a bent pier type of mounting also of Mr. Barnard's design. With this form of mounting it is possible to make long exposures, during which the object photographed crosses the meridian, without reversing the telescope. Many beautiful negatives of the Milky Way, faint nebulosities and comets have been taken by our medalist with this instrument. Some of these have been published in the volumes of the *Astrophysical Journal*.

In the year 1905, Dr. Barnard took the Bruce telescope to the Mount Wilson Solar Observatory, for the purpose of photographing some of the southern regions of the Milky Way, which could not be reached from the more northern latitude of the Yerkes Observatory.

Mr. Barnard's photographs of the Milky Way and of faint nebulosities have shown the existence of many small areas or dark holes, apparently devoid of stars, and these located in the regions of greatest star density. Our medalist has advocated the theory, first suggested by A. C. Ranyard, that these so-called holes are not areas or spaces devoid of stars, but spaces from which the light of the stars is cut off from the Earth by an intervening opaque body. He gives observational evidence and many reasons to support this theory, and has apparently made out a very good case. A year ago, we had the pleasure of listening to a lecture by Dr. Barnard on this subject, and of seeing many slides made from his beau-

tiful photographs of these interesting regions of the sky. The "holes" in the nebulosity near ρ *Ophiuchi* and ν *Scorpii* are two of the most conspicuous examples of this phenomena.

The theory seems inherently more probable than that of holes thru the Milky Way. The question of the existence of dark bodies in the universe is a very interesting one, but one about which it has been possible thus far to get but little evidence. Outside the solar system we see only such bodies as are self luminous. Is it not possible that these constitute only a small fraction of the matter of the universe? The spectroscope reveals to us bodies that we cannot see. In the solar system the Sun is the only self luminous body,—comets possibly excepted. Counting planets, satellites, asteroids and comets, there are perhaps a thousand bodies in the solar system, only one of which may be seen from the distance of the stars. If we include meteors, then there are millions of bodies in the solar system only one of which may be seen from a great distance. It is, of course, not logical to draw general conclusions from single cases, but as hot bodies are always radiating heat, and usually becoming cooler, and cold bodies never become hotter except thru some special agencies, it would seem to be easier to defend the proposition that the universe contains more non-luminous bodies than luminous ones, than to defend the converse. There would appear, therefore, nothing inherently improbable about Mr. Barnard's hypothesis of dark opaque bodies in space.

Our medalist's activity has extended into nearly every field of observational astronomy. He observed three total solar eclipses,—the California eclipse of January 1, 1889, the Georgia eclipse of 1900, and the Sumatra eclipse of 1905. Besides the objects already mentioned he has observed double stars, variable stars, and nearly every kind of celestial object or phenomenon. Time does not permit of an adequate consideration of his numerous activities.

Before closing, however, I wish to mention one of his most recent discoveries,—a faint star in *Ophiuchus* having a proper motion of $10''.3$, which is greater than any other proper motion known. This star is about the tenth visual magnitude and of the eleventh photographic magnitude. This discovery was

made by comparing plates of this region of the sky, taken in 1894 and 1904, with some of more recent date, and illustrates the great value of our medalist's early photographic work. Preliminary determinations of the parallax of this star have been made by Schlesinger and by Russell, placing the value between $0''.5$ and $0''.7$, which, with the exception of α Centauri, makes this star the nearest known neighbor of the solar system.

The results of Mr. Barnard's astronomical work have been published in a great many journals and a bibliography of his published articles would make a list of several hundred titles. He has been elected to membership in many societies, and has received many marks of distinction, including the receipt of the gold medal of the Royal Astronomical Society of England, given in 1897 for the discovery of the fifth satellite of *Jupiter*; of the Lalande gold medal of the Paris Academy, the Arago gold medal, and the Janssen gold medal.

A tireless worker, possessed of a burning esthusiasm for the science of astronomy, our medalist has won for himself thru his observations, his writings, his photographs, his lectures, his kindly spirit and lovable nature, a place of esteem among his fellow men, and we who know him personally count it a privilege to be reckoned among his friends.

We regret exceedingly that it is not possible for our medalist to be with us this evening to receive this Bruce medal in person,—a token of our esteem and a slight reward for his life-long devotion to our service. In his absence, may I ask you, Mr. Secretary, to transmit the medal to Mr. Barnard, and to send with it our best wishes for many years of health and happiness, in which he may continue to devote his time and energy to the science he loves so well.